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3M Occupational Health and Environmental Safety Division

3M™ WIBGET™ Heat Stress Monitor WB-300

3M WIBGET WB-300 Heat Stress Monitor

WIBGET WB-300 User Manual

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3M™ WIBGET™ Heat Stress Monitor WB-300 User Manual

Dangers, warnings and cautions

Danger!

Failure to observe the following procedures may result in serious personal injury

- This instrument is not intrinsically safe, do not use in hazardous locations.

Warning!

Failure to observe the following procedures could damage the instrument

- Read the manual before operation.
- Do not store in temperatures exceeding 100°C (212 °F)
- Do not immerse in liquids.
- Condensation may damage your instrument.
- Substitution of components may impair the accuracy of the instrument. Repair should be completed by authorized service personnel only.

Caution!

General

- Replacement of 9-V alkaline battery only in a non-hazardous locations.
- If recharging with a NiHM Battery pack, recharge only in a non-hazardous environment.
- A non-condensing environment is required for proper measurements.
- Do not charge battery outside the range of 0°C to 40°C (32°F to 104°F).
- Battery run-time may be reduced when operating at lower than 0°C (32°F) temperatures.

Intended Use

The WIBGET WB-300 is intended to measure environmental temperatures for heat stress analysis. Consult your company's safety professional for local standards.

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Up and Running

1. Ensure the wet bulb's wick is clean. Then, fill the reservoir with distilled water.
2. Place the WB-300 in the work area in a safe location approximately 3.5 feet off the ground.
3. Turn the instrument On by pressing I/O Enter key.
   - If the battery voltage displayed during the power-on sequence is less than or equal to 6.4 volts, replace or recharge the batteries.
4. Using the Arrow keys, select the desired measurement/parameter screen.
5. Allow 10 minutes for the sensors to stabilize to the environment before taking readings.

Check wick and fill natural wet bulb

The WB-300 uses a cotton wick immersed into a reservoir containing distilled water. Ordinary tap water should not be used, as the contaminants that are left behind after evaporation will shorten the life of the wick and cause high readings. If the wick is discolored it should be replaced. To replace the wick, slide the old wick off the top of the sensor. Place a new wick over the sensor, making sure that the bottom of the wick is down in the reservoir.

Filling wet bulb reservoir

1. Remove reservoir cover and fill with distilled or de-ionized water.
2. Replace reservoir cover.

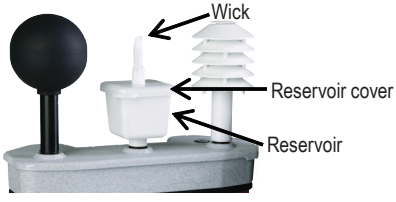

Figure 1: Wet bulb and maintenance

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Keypad Operation

The unit operates using a membrane keypad with 4 keys. The I/O Enter key responds when the key is released while all other keys respond when the key is pressed.

Keys	Explanation
I/O Enter	The I/O Enter key is used to turn on and off the instrument and to enter setup changes. **Turning on:** Press and release the I/O enter key to power on. The Instrument name (WIBGET), revision number, and battery information appears during start-up. **Turning off:** Hold the I/O key down while a count-down 3-2-1 occurs in the lower left hand corner of the display. **Enter setup changes:** While in Setup screen, press to enter (or select) setup changes.
Setup	The Setup key allows changing the setup parameters. Two parameters are available: Celsius or Fahrenheit and language selection. **Setup:** Press setup to access the parameters. Use the arrow keys to switch between the two parameters. Press the enter key to change the parameters. Press setup again to exit.
Up Arrow	The ▲ key changes which items appear on the display. Scrolls up.
Down Arrow	The ▼ key changes which items appear on the display. Scrolls down.

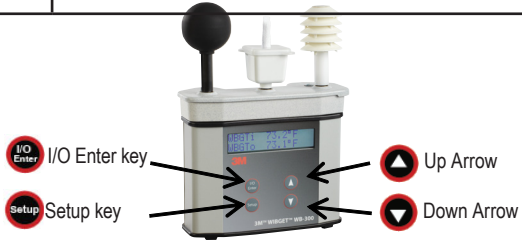

Figure 2: Keypad keys identified

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Sensors

Natural Wet Bulb Thermometer

The natural wet bulb thermometer gives an indication of the effects of humidity on an individual. Relative humidity and air flow are taken into account by measuring the amount of evaporative cooling taking place at a thermometer covered with a moistened wick. The WB-300 uses a cotton wick immersed into a reservoir containing distilled water. Ordinary tap water should not be used, as the contaminants that are left behind after evaporation will shorten the life of the wick and cause high readings. If the wick is discolored it should be replaced. To replace the wick, slide the old wick off the top of the sensor. Place a new wick over the sensor, making sure that the bottom of the wick is down in the reservoir.

Globe Thermometer

The globe thermometer gives an indication of the radiant heat exposure on an individual due to either direct light or hot objects in the environment. This is accomplished by placing a temperature sensor inside a blackened copper sphere and measuring the temperature rise. The WBGT index is based on the response of a 6 inch diameter globe. The WB-300 uses a 2 inch diameter globe for a faster response time. The temperature of the 2 inch globe is correlated to match that of a 6 inch globe. As an option, a sensor array with a 6 inch diameter globe is available.

As an option, a sensor array with a 6 inch diameter globe is available.

Dry Bulb Thermometer

The dry bulb thermometer measures the ambient air temperature. This measurement is used in the outdoor WBGT calculation when a high solar radiant heat load may be present. The series of white plates surrounding the sensor shield it from radiant heat.

A. Globe thermometer
B. Natural wet bulb thermometer
C. Dry bulb thermometer

Figure 3: Sensors identified

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Measurements

The WB-300 portable heat stress monitor computes the Wet Bulb Globe Temperature (WBGT). The WBGT is an accepted measurement for determining the heat stress level imposed on an individual in a given environment.

The WB-300 measures three parameters:

- Ambient or dry bulb temperature (DB)
- Natural wet bulb temperature (WB)
- Globe temperature (G)

Wet Bulb Globe Temperature

The WBGT is a weighted average of the three temperature sensors using the following formulas:

WBGT (indoor) = 0.7 WB + 0.3G (denoted as "WBGTi" on the display)

WBGT (outdoor) = 0.7WB + 0.2G + 0.1DB (denoted as "WBGTo" on the display)

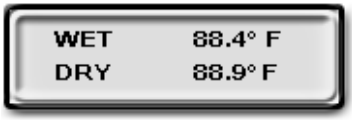
☑ **NOTE:** *The resulting WBGTi/WBGTo can be compared to indices of work-rest regimens (or stay times) based upon the work loads. Please see Appendix B for published heat exposure tables.*

Displayed Data

When powered on, the previously viewed measurement screen will be displayed. To view data screens, press the or keys.

Data Screens

The following four screens are viewable by pressing the or keys on the WB-300.



Wet/Dry Measurement screen

Globe Measurement screen

WBGTi/WBGTo Measurement screen

Battery screen

Figure 4: Data/measurement screen examples

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Setup

While powered on, press the setup key to change the temperature units (°F/°C) or the language settings (English, Spanish, French, Italian, or German), if desired.

Placing the WB-300 on-site for monitoring/testing

The WB-300 should be placed at a height of 3.5 feet (1.1m) for standing individuals or 2 feet (.6m) for seated individuals. Tripod mounting is recommended to get the unit away from anything that might block radiant heat or airflow. A 1/4"x20 threaded bushing on the bottom of the instrument allows mounting to a standard photographic tripod. Do not stand close to the unit during sampling.

Make sure that the wet bulb reservoir is filled with distilled water and that the cotton wick is clean and fully wetted. After adding water or placing the unit in a new environment, allow ten minutes for the globe and wet bulb readings to stabilize.

A series of dashes appear in the display if one of the following occur:
- The temperature is outside of its allowable range
- A temperature sensor has failed

Operational Check

A verification module, 3M ID: 70071581246, may be used to check the operation of the WB-300. Remove the top sensor bar and plug the verification module into the top of the unit. With the WB-300 set to read in degrees Celsius, verify that the displayed readings match those printed on the module within +/-0.5°C.

If the readings are not within the +/-0.5°C tolerance, then have the unit serviced and calibrated.

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Power Options

There are 3 options for powering the WB-300: a 9-volt alkaline battery, a NiMH (Nickel Metal Hydride) rechargeable 6-cell battery pack, and an AC adapter. A door on the back of the instrument allows the user access to the 9-volt battery. The rechargeable battery pack is located inside of the unit. If the rechargeable battery pack ever needs to be replaced, it can be accessed by removing the screws from the bottom panel of the unit.

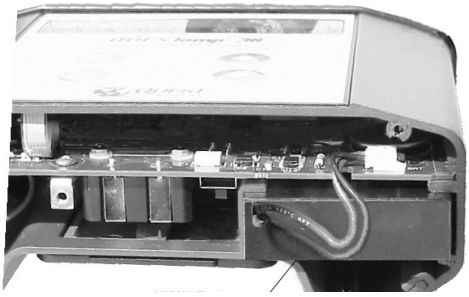
The 2-position switch located in the battery compartment must be set by the user if the power supply method is changed. The up position is for the 9-volt battery. The down position allows for either the AC adapter or the rechargeable batteries. The AC adapter will trickle charge the rechargeable batteries if they are in place or it will simply allow for line power operation of the unit.

9-V Alkaline Battery Replacement

The 9-volt battery should be replaced or the NiMH battery pack should be recharged when the voltage drops below 6.4 volts. The battery voltage is displayed when the instrument is turned on. While turned on, the battery voltage can be displayed at any time by pressing the up or down arrow keys to move through the display until the battery voltage screen appears. If, while operating, the battery voltage drops below 6.4 volts, the display will automatically switch to the display showing the battery voltage along with a low battery message. After a low battery occurs, the unit will continue to operate for approximately 8 hours. When the battery voltage falls to 6.2 volts or below, the unit will automatically turn off.

NiMH Battery Pack

The NiMH rechargeable battery pack is charged in the instrument using 120VAC to 9VDC adapter. A discharged battery pack requires a charge of 16 hours. Leaving the AC adapter plugged in for extended lengths of time or when operating the instrument will not harm the rechargeable batteries.



NiMH Battery Pack
To install, slide into case and plug in connector as shown.

Figure 5: NiMH Battery Pack

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Appendix A: Specifications

Measurements
- Globe, dry bulb, wet bulb, WBGTi, (WBGT indoor) and WBGTo (WBGT outdoor).
- Temperatures given in Celsius or Fahrenheit.

Languages
English, French, Spanish, Italian, German.

Housing
Designed water resistant to a light rain or mist. If rain is frequent, best practice would be to remote the sensor bar and keep the instrument sheltered. (Note: when top sensor bar is removed, an optional cable can be attached to measure remotely.)

Size
Height 9.2in (23.5cm); Width 7.2in (18.3mm); Depth 3.0in (7.5mm)
Dimensions include mounted sensor assembly.

Weight
2.6 lbs. (1.2 kg) with mounted sensor assembly.

Sensor Types
Temperature: 1000 ohm platinum RTD

Accuracy
Temperature: +/-0.5°C between 0°C to 100°C (+/- 0.9° F between 32° F to 212°F)

Operating Temperature Range
Sensor Assembly: -5°C to 100°C (23°F to 212°F)
Electronics: -5°C to 60°C (23° F to 140° F)

Power Options
9V alkaline, 7.2V NiMH rechargeable pack (charged in the unit), or AC adapter wall power cube (AC adapter will power the unit or recharge the NiMH battery pack).

Battery Life
9V alkaline: 140 hours
Rechargeable Nickel Metal Hydride: 300 hours

Charge Time (NiMH Battery Pack)
16 hours (charge in the unit)

Safety Approvals and Special Conditions
CE mark
Compliance with Essential Health and Safety Requirements has been assured by compliance with: EN 50014 : 1997 and EN 50020 : 2002
The year of manufacture is determined by the third character in the instrument's serial number. "A" was manufactured in 2001, "B" in 2002, "C" in 2003, "D" in 2004 and so forth.

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Appendix B: Heat Exposures Tables

ACGIH

Screening Criteria for Heat Stress Exposure. WBGT values in °C.

- NOTE: according to the ACGIH's guidelines, the temperature values represent a work and rest process which is explained in the standards. Please refer to the ACGIH TLV's and BEIs for specific details.

Work and recovery (TLV)	Light	Moderate	Heavy	Very Heavy
75% to 100%	31.0	28.0	26.0*	23.5*
50% to 75%	31.0	29.0	27.5	25.5*
25% to 50%	32.0	30.0	29.0	28.0
0% to 25%	32.5	31.5	30.5	30.0

Work and recovery (Action Limit)	Light	Moderate	Heavy	Very Heavy
75% to 100%	28.0	25.0	22.5*	20.0*
50% to 75%	28.5	26.0	24.0	22.5*
25% to 50%	29.5	27.0	25.5	24.5
0% to 25%	30.0	29.0	28.0	27.0

*Values not specified by ACGIH have been estimated for continuity.
Cited from "American Conference of Governmental Industrial Hygienists - Threshold Limit Values and Biological Exposure Indices for 2008"; Reprinted with permission from ACGIH

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PHEL Curves (Total Exposure Time in Hours: Minutes)

WBGT (°F)	I	II	III	IV	V	VI
80.0	>8:00	>8:00	>8:00	8:00	6:35	4:30
81.0	>8:00	>8:00	>8:00	8:00	6:35	4:30
82.0	>8:00	>8:00	8:00	7:05	5:25	3:40
83.0	>8:00	8:00	7:45	6:25	4:55	3:20
84.0	>8:00	8:00	7:05	5:55	4:30	3:05
85.0	8:00	7:45	6:30	5:20	4:05	2:50
86.0	8:00	7:05	5:55	4:55	3:45	2:35
87.0	7:25	6:30	5:25	4:30	3:25	2:20
88.0	6:45	5:55	4:55	4:05	3:10	2:10
89.0	6:10	5:25	4:30	3:45	2:50	2:00
90.0	5:40	5:00	4:10	3:25	2:40	1:50
91.0	5:15	4:35	3:50	3:10	2:25	1:40
92.0	4:50	4:10	3:30	2:55	2:15	1:30
93.0	4:25	3:50	3:15	2:40	2:00	1:25
94.0	4:05	3:35	3:00	2:25	1:50	1:15
95.0	3:45	3:15	2:45	2:15	1:45	1:10
96.0	3:25	3:00	2:30	2:05	1:35	1:05
97.0	3:10	2:45	2:20	1:55	1:25	1:00
98.0	2:55	2:35	2:10	1:45	1:20	0:55
99.0	2:40	2:20	2:00	1:40	1:15	0:50
100.0	2:30	2:10	1:50	1:30	1:10	0:45
101.0	2:20	2:00	1:40	1:25	1:05	0:45
102.0	2:10	1:50	1:35	1:15	1:00	0:40
103.0	2:00	1:45	1:25	1:10	0:55	0:35
104.0	1:50	1:35	1:20	1:05	0:50	0:35
105.0	1:40	1:30	1:15	1:00	0:45	0:30
106.0	1:35	1:25	1:10	0:55	0:45	0:30
107.0	1:30	1:15	1:05	0:50	0:40	0:25
108.0	1:20	1:10	1:00	0:50	0:35	0:25
109.0	1:15	1:05	0:55	0:45	0:35	0:25

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Product Information

- WIBGET WB-300 Heat Stress Monitor kit, includes 9V alkaline battery, replacement wicks, water bottle, verification module, storage case, and user manual. (3M ID: 70-07160781-9)

Accessories

Product No.	Description	3M ID
056-795	3M™ Sensor array with 2 inch globe (one included)	70-0715-8658-3
056-780	3M™ Sensor array with 6 inch globe (one included)	70-0715-8656-7
015-910	3M™ 120VAC to 9VDC transformer/power adapter	70-0715-8174-1
015-680	3M™ 220VAC to 9VDC transformer/power adapter	70-0715-8507-2
059-045	3M™ Tripod	70-0715-8374-7
056-679	3M™ Replacement wicks	70-0715-8373-9
053-923	3M™ Verification module	70-0715-8124-6
056-068	3M™ 2 oz water bottle	70-0715-8371-3

Warranty

3M™ WIBGET™ WB-300 LIMITED WARRANTY.
3M warrants the WIBGET WB-300 will be free from defective materials and workmanship **for one year from date of purchase (**indicated on the sales receipt), provided it is maintained and used in accordance with 3M™ instructions and/or recommendations. If any component becomes defective during the warranty period, it will be replaced or repaired free of charge. This warranty does not apply to units that have been altered or had repair attempted, or that have been subjected to abuse, accidental or otherwise. The above warranty is in lieu of all other express warranties, obligations or liabilities. THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE ARE LIMITED TO one year FROM THE PURCHASE DATE. 3M™ shall not be liable for any other warranty, express or implied, arising out of or related to the appropriate use of environmental temperature measurement data for heat stress related issues. Manufacturer or its agent's liability shall be limited to replacement or repair as set forth above. Buyer's sole and exclusive remedies are return of the goods and repayment of the price, or repair and replacement of defective goods or parts.

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